Jiro TANAKA* & Mitsuo CHIHARA*: **Taxonomic study of the Japanese crustose brown algae (6) *Pseudolithoderma* (Lithodermataceae, Ralfsiales)****

田中次郎*・千原光雄*: 日本産殼状褐藻の分類学的研究 (6) ニセイシノカワ属 (イシノカワ科, イソガワラ目)

Lithodermataceae Hauck, Die Meeresalg. Deutsch. u. Oesterr. *In* L. Rabenhorst's Kryptogam.-Flora v. Deutsch, Oesterr. u. Schweiz. 2nd ed., **2**: 318 (1883).

Thallus crustose, expanded; vegetative erect filaments firmly or loosely adjoined with each other; both unilocular and plurilocular reproductive organs terminally formed; chloroplast single to many.

Type genus: *Lithoderma* Areschoug (1875).

The family Lithodermataceae is characterized by possession of unilocular and plurilocular reproductive organs formed terminally. This family currently includes the following six genera: *Lithoderma* Areschoug 1875; *Symphyocarpus* Rosenvinge 1893; *Sorapion* Kuckuck 1894; *Petroderma* Kuckuck 1897; *Pseudolithoderma* Svedelius 1910; *Heribaudiella* (Gomont) Svedelius 1930. These genera can be distinguished by a combination of the following characters; 1) the number of chloroplast per cell, 2) the degree to which erect filaments adjoin each other, 3) the thickness of the thallus and 4) the morphology of the plurilocular and unilocular reproductive organs.

The genus *Porterinema* Waern was placed in the Lithodermataceae by Waern (1952) based only on possession of terminal unilocular sporangia resembling those of *Sorapion* and *Lithoderma*. However, considering that the thallus is composed of only creeping filaments attached to the substratum and it lacks clear erect filaments and furthermore bears peculiar intercalary plurilocular reproductive organs unknown in other members of the Ralfsiales, *Porterinema* should be excluded from the Lithodermataceae and probably from the Ralfsiales.

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These three characteristics have never been described for the families Lithodermataceae and Ralfsiaceae.

The genus *Heribaudiella* is known to occur only in fresh water. In Japan the occurrence of *H. fluviatilis* has been reported by Kumano and Hirose (1969). Members of this family seem to be distributed mainly in northern waters. *Pseudolithoderma* is the first genus of marine Lithodermataceae to be recorded for Japan.

Pseudolithoderma Svedelius *in* Engl. et Prantl. Nat. Pflanz.-fam. Nachträge, z. Teil 1, Abt. 2. p. 175 (1910).

Thallus thinly crustose, expanded in only diameter, firmly attached to the substratum without rhizoids; basal layer composed of one or two rows of cells; erect filaments arising from basal layer, strictly erect, simple or sparsely branched, loosely or firmly adjoined, more or less to form pseudoparenchyma; tuft of hairs occasionally arising from a basal layer; cells containing several discoid chloroplasts; both types of reproductive organs terminal on the erect filament.

Type species: *Pseudolithoderma extensum* (Crouan) S. Lund.

The genus *Pseudolithoderma* was erected by Svedelius (1910) after study of *Lithoderma fatiscens* Kuckuck and is characterized by the following: 1) several disc-shaped chloroplasts per cell, 2) terminal unilocular sporangia and 3) plurilocular reproductive organ being borne only at the terminal position. According to Svedelius, the presence of only the terminal plurilocular reproductive organ is a character to separate *Pseudolithoderma* from the closely related genus *Lithoderma*, which has lateral plurilocular reproductive organs in addition to terminal ones. Some of the species which have been placed in *Lithoderma* possess only terminal plurilocular organs as reproductive structures and because of this they have been transferred to the genus *Pseudolithoderma* by Lund (1959). Currently, six species are accepted as the taxa of the genus *Pseudolithoderma* and most occur in the north Atlantic Ocean.

Species belonging to this genus can be distinguished from one another by the use of a combination of the following characteristics: 1) the degree to which erect filaments adjoin each other, 2) the texture of the thallus: smooth or rough, and sticky or not, and 3) the shape and size of both types of reproductive organ.

In order to clarify the life history of this genus, culture study was undertaken by Loiseaux (1968) using *Pseudolithoderma roscoffensis*. According to her, swarmers from plurilocular reproductive organs gave rise to the mother plant, the plurilocular organ bearing thallus. This fact suggests the occurrence of apomeiotic division in sporogenesis.

Pseudolithoderma subextensum (Waern) S. Lund, Meddel. om Grønland **156**: 84 (1959).

Basionym: *Lithoderma subextensum* Waern, Sv. Bot. Tidskr. **43**: 659. fig. 4, pl. 1, h and pl. 3 (1949); Acta Phytogeogr. Suecica **30**: 148. fig. 67 (1952).

Thallus crustose, expanded in diameter, epilithic, dark, chestnut brown, mostly circular in outline, reaching up to 1 cm in diameter and 250 μm thick, often confluent and covered with thin gelatinous layer in surface, composed of a basal layer and erect filaments; basal layer 2-3 cells thick, creeping on substratum; cells of basal layer 10-16 μm broad and 0.3-0.6 times as high as wide in lower part of thallus, 8-10 μm broad and 1.0-1.4 times as high as wide in upper part; cells filled with spheres of granular storage substance about 5 μm

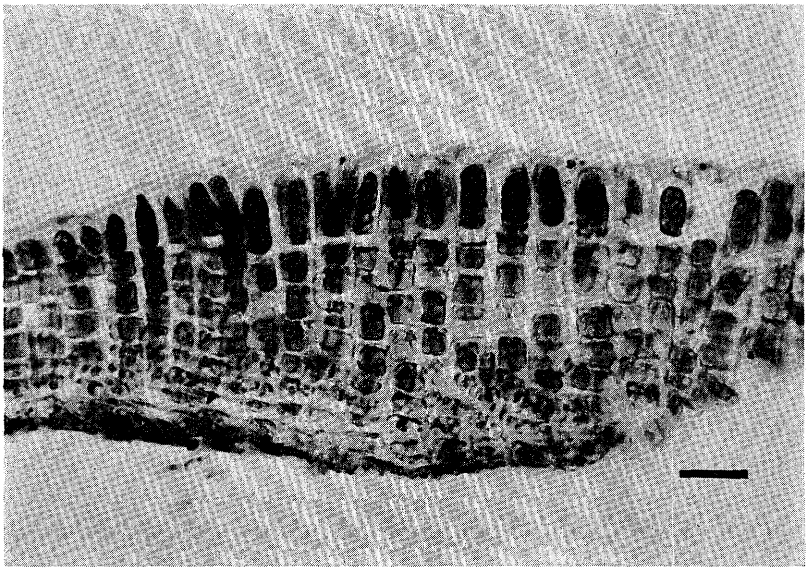

Fig. 1. *Pseudolithoderma subextensum*. Longitudinal section of young thallus with an immature unilocular sporangial sorus, showing basal layer, erect filaments and young unilocular sporangia. Scale = 20 μm.

in diameter; chloroplasts disc-shaped or irregular in shape, several per cell; hairs in tufts arising from a basal layer; both types of reproductive organs terminally arising from erect filaments, cylindrical, rounded at the apex, 20-33 μm long and about 10 μm in diameter; plurilocular reproductive organs first cylindrical, later forming somewhat irregular cluster of spores, 20-40 μm long and 10-14 μm in diameter; ascocyst-like paraphyses associated with unilocular sporangia, these being of same size and shape as unilocular sporangia, terminal on erect filaments.

Habitat. Growing often mixed with species of *Ralfsia* on rocks or pebbles in the upper to lower intertidal zone.

Type locality. Oregrund Archipelago, Sweden (as *Lithoderma subextensum* Waern).

Geographical distribution. Sweden. The genus and the species are newly reported from Japan.

Representative specimens examined. Shimoda, Shizuoka-ken, Oct. 25, 1977 (TKB 1360); the same, Nov. 8, 1979 (TKB 1361).

In the light of the descriptions and illustrations originally given by Waern (1949), based on specimens from Sweden, we have found the present alga to be similar to *Pseudolithoderma subextensum* (Waern) S. Lund. This species is characterized by the following features; 1) firmly adjoining erect filaments forming a rigid thallus, 2) crust covered with a gelatinous layer, 3) several disc-shaped chloroplasts per cell, 4) terminal, cylindrical or somewhat irregularly shaped, plurilocular reproductive organs. This combination of characteristics has not been found in any other described species of *Pseudolithoderma*. However, it should be pointed out that the present alga differs from *P. subextensum* in the following respects. In the present alga, hairs arise from a basal layer, and only one type of reproductive organ is borne on a thallus, whereas in *P. subextensum*, hairs arise from the terminal cell of erect filaments and both types of reproductive organs are sometimes present on the same thallus. Moreover, the present alga possesses ascocyst-like paraphyses associated with unilocular sporangia, and these structures were not noted in Waern's description and illustrations (1949, 1952), nor in Lund's (1959) treatment of *P. subextensum*. These structures are characteristic of some taxa of the genus *Myrionema* (Loiseaux, 1967), and of the Scytosiphonales (Setchell & Gardner, 1925). Hollenberg (1969) described and illustrated such structures associated with the

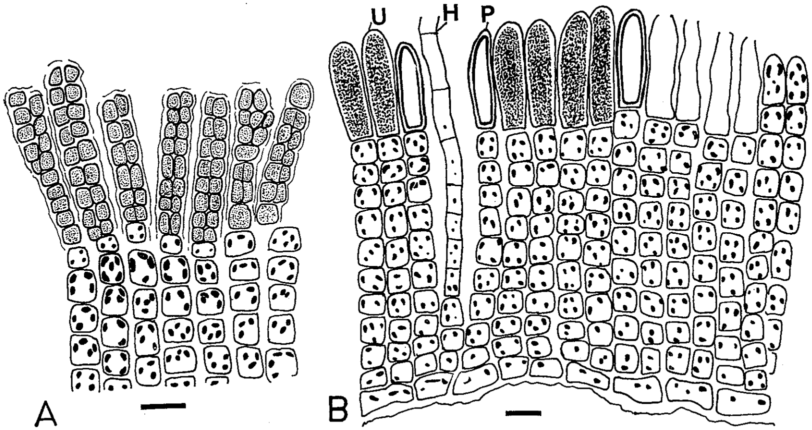

Fig. 2. *Pseudolithoderma subextensum*. A. Longitudinal section of thallus with plurilocular reproductive organs, showing cylindrical or somewhat irregular shaped plurilocular reproductive organs, and several chloroplasts per cell. B. Longitudinal section with mature unilocular sporangial sorus, showing six mature sporangia (U), three ascocyst-like paraphyses (P), four empty sporangia and a hair (H). Scale=10 μm.

plurilocular reproductive organs of *Pseudolithoderma nigra*. However, the ascocyst-like paraphyses associated with unilocular sporangia are reported here for the first time for a species of the genus *Pseudolithoderma*.

P. subextensum can be distinguished from *P. paradoxum* Sears et Wilce (1973) and *P. rosenvingii* (Waern) S. Lund (1959) which have soft thalli, by its rigid thallus; from *P. nigra* Hollenberg (1969) which has a thickness of 300-500 μm or more, by its thinner thallus; from *P. roscoffensis* Loiseaux (1968) which possesses regular rows of plurilocular reproductive organs and no unilocular sporangia, by its irregular clusters of plurilocular organ and its terminal unilocular organs; and from *P. extensum* (Crouan) S. Lund (1959) which possesses globose unilocular sporangia and no hairs, by its cylindrical unilocular sporangia and hairs.

If sterile, *P. subextensum* can be distinguished from members of *Ralfsia* which have similar vegetative structures by the presence of several large spheres of storage substances and several chloroplasts per cell.

References

Hollenberg, G. J. 1969. An account of the Ralfsiaceae (Phaeophyta) of California. J. Phycol. **5**: 290-301. Kumano, S. & H. Hirose. 1959. On the swarmers and reproductive organs of a phaeophyceous fresh-water alga of Japan *Heribaudiella fluviatilis* (Areschoug) Svedelius. Bull. Jap. Phycol. **7**: 45-51. Loiseaux, S. 1967. Morphologie et cytologie des Myrionémacées, criteres taxonomiques. Rev. Gén. Bot. **74**: 329-347. 3 pls. —— 1968. Recherches sur les cycles de développement des Myrionématacées (Phéophycées) III. Tribu des Ralfsiées, IV. Conclusions générales. Rev. Gén. Bot. **75**: 295-318. Lund, S. 1959. The marine algae of East Greenland. I. Taxonomical part. Meddel. om Grønland. **156**: 1-247. 42 figs. Sears, J. R. & R. T. Wilce. 1973. Sublittoral benthic marine algae of southern Cape Cod and adjacent islands: *Pseudolithoderma paradoxum* sp. nov. (Ralfsiaceae, Ectocarpales). Phycologia **12**: 75-82. Setchell, W. A. & N. L. Gardner. 1925. The marine algae of the Pacific coast of North America, Part III. Melanophyceae. Univ. Calif. Publ. Bot. **8**: 383-898. 74 pls. Svedelius, N. *In* Kjellman, F. R. & N. Svedelius. 1910. Lithodermataceae. *In* Engl. u. Prantl, Die nat. Pflanz. -fam. Nachträge z. Teil 1, Abt. 2. Leipzig. pp. 173-176. figs. 97-99. Waern, M. 1949. Remarks on some Swedish *Lithoderma*. Sv. Bot. Tidskr. **43**: 633-670. 3 pls. —— 1952. Rocky-shore algae in the Oregrund Archipelago. Acta Phytogeogr. Suecica **30**: 1-298.

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本報告ではイシノカワ科に属するニセイシノカワ属の1種 *Pseudolithoderma subextensum* の記載を行った。この分類群は属，種ともに日本新産である。ニセイシノカワ属は主として次の分類学的形質によりイシノカワ科の他の属と区別される。1)葉緑体は1細胞中に複数存在する。2)単子のうと複室生殖器官を有し，両者とも直立栄養細胞糸に頂生する。*P. subextensum* は主に次の形質の組み合せにより他の種と区別される。1)直立糸は側面で結合し，固い擬柔組織をつくる。2)体表面はうすい粘液物質におおわれる。3)細胞内に数個 (3〜5個) の葉緑体を有する。4)単子のうと複室生殖器は長円柱形である。静岡県下田産。